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Abstract

Two-thousand two-hundred fifty-two yearling steers (690 lb) were used to evaluate the effects of Optaflexx and days on feed on finishing steer performance and carcass characteristics. Treatment groups included serial harvest dates of 150, 171, or 192 days. Within each harvest date, steers either received Optaflexx (200 mg/steer daily of ractopamine-HCl) for the final 28 days, or did not receive Optaflexx. All steers were initially implanted with Revalor-IS and were re-implanted with Revalor-S after 75 days on feed. At harvest, muscle samples from the inside round were obtained for mRNA analysis of the β- adrenergic receptors (AR). Optaflexx increased daily gains, hot carcass weight, and ribeye area, and improved feed efficiency. Optaflexx did not affect dressing percentage, USDA yield grade, or quality grade. Optaflexx did not change overall feed intake across the entire feeding period, but feed intake was increased during the 28-day period that steers received Optaflexx. As expected, greater days on feed decreased daily gains, overall feed intake, and the number of yield grade 1 and 2 carcasses, and worsened feed efficiency. Also, greater days on feed increased hot carcass weight, dressing percentage, and the number of prime and choice carcasses, as well as the number of yield grade 4 and 5 carcasses. Increasing days on feed decreased the abundance of mRNA for β1-AR and β3-AR, and increased the abundance of β2-AR mRNA. Optaflexx had no effect on abundance of mRNA for β1-AR or β3-AR, but it increased the abundance of mRNA for β2-AR. Optaflexx may affect expression of the β2-AR gene in skeletal muscle, which could impact the performance responses to Optaflexx feeding in steers.

Keywords

Cattlemen's Day, 2006; Kansas Agricultural Experiment Station contribution; no. 06-205-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 959; Beef; Optaflexx; Carcass characteristics; Skeletal muscle gene expression; Yearling steers

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EFFECT OF OPTAFLEXX[1] AND DAYS ON FEED ON FEEDLOT PERFORMANCE, CARCASS CHARACTERISTICS, AND SKELETAL MUSCLE GENE EXPRESSION IN YEARLING STEERS

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Summary

Two-thousand two-hundred fifty-two yearling steers (690 lb) were used to evaluate the effects of Optaflexx and days on feed on finishing steer performance and carcass characteristics. Treatment groups included serial harvest dates of 150, 171, or 192 days. Within each harvest date, steers either received Optaflexx (200 mg/steer daily of ractopamine-HCl) for the final 28 days, or did not receive Optaflexx. All steers were initially implanted with Revalor[4]-IS and were re-implanted with Revalor-S after 75 days on feed. At harvest, muscle samples from the inside round were obtained for mRNA analysis of the β-adrenergic receptors (AR). Optaflexx increased daily gains, hot carcass weight, and ribeye area, and improved feed efficiency. Optaflexx did not affect dressing percentage, USDA yield grade, or quality grade. Optaflexx did not change overall feed intake across the entire feeding period, but feed intake was increased during the 28-day period that steers received Optaflexx. As expected, greater days on feed decreased daily gains, overall feed intake, and the number of yield grade 1 and 2 carcasses, and worsened feed efficiency. Also, greater days on feed increased hot carcass weight, dressing percentage, and the number of prime and choice carcasses, as well as the number of yield grade 4 and 5 carcasses. Increasing days on feed decreased the abundance of mRNA for β_1-AR and β_3-AR, and increased the abundance of β_2-AR mRNA. Optaflexx had no effect on abundance of mRNA for β_1-AR or β_3-AR, but it increased the abundance of mRNA for β_2-AR. Optaflexx may affect expression of the β_2-AR gene in skeletal muscle, which could impact the performance responses to Optaflexx feeding in steers.

Introduction

Previous results with Optaflexx, an approved β-adrenergic agonist for beef cattle, have demonstrated increased daily gains, improved feed efficiency, increased carcass weight gain, and sometimes a slightly enhanced yield grade without detrimental effects on quality grade. No studies have determined if the response to Optaflexx is affected by the length of the total feeding period. Further, many studies report that the active ingredient of Optaflexx, ractopamine-HCl, functions as a β_1-adrenergic receptor agonist. Previous research has suggested that exposure to a β-

[1]Optaflexx is a registered trademark of Elanco Animal Health, Indianapolis, IN.
[2]Intervet, Inc.
[3]Cactus Research, LTD.
[4]Revalor is a registered trademark of Intervet, Inc.

agonist, such as ractopamine-HCl, can affect the amount of the β-adrenergic receptor (AR) through which ractopamine mediates its biological effect.

The objectives of our study were to evaluate the effects of feeding Optaflexx to yearling steers, harvested at three different harvest dates, on performance, carcass characteristics, and the abundance of β-adrenergic receptor mRNA in skeletal muscle tissue.

Experimental Procedures

This study was a collaboration between Intervet, Inc. (Millsboro, DE), Cactus Research, LTD, and Kansas State University. Two-thousand two-hundred fifty-two English × Continental steers (690 lb initial weight) were fed at Cactus Research, LTD. Treatments were arranged in a 3 × 2 factorial, and the experiment used a randomized complete-block design. Steers were blocked by arrival time, randomly assigned to treatments within block, and allotted to 24 pens, with 91 to 97 steers per pen. Pens of steers were assigned to harvest dates of 150, 171, or 192 days. Within each harvest date, steers either received Optaflexx (200 mg/steer daily of ractopamine-HCl) for the final 28 days, or did not receive Optaflexx (control). Upon entering the feedyard, steers were implanted with Revalor-IS (80 mg trenbolone acetate and 16 mg estradiol-17β), and 75 days later were reimplanted with Revalor-S (120 mg trenbolone acetate and 24 mg estradiol-17β). USDA yield and quality grades were obtained at harvest.

At harvest, a muscle sample was collected from the inside round of four randomly selected steers in each pen, snap-frozen, and shipped to the growth lab at Kansas State University. Samples were stored at -112°F, and RNA was isolated from the muscle tissue of two steers in each group. RNA was isolated by using the TRI Reagent RNA isolation technique. After isolation, RNA quality and quantity were measured; then the abundance of mRNA for β_1-AR, β_2-AR, and β_3-AR was measured by using a reverse transcription-polymerase chain reaction procedure.

Results and Discussion

Feeding Optaflexx increased average daily gain by 4.6% and improved feed efficiency by 3.8% (Table 1). There was no overall change in dry matter intake in response to Optaflexx during the entire feeding period, but during the 28 days in which Optaflexx was fed, feed intake did increase by 3.5%, compared with that of controls (data not shown).

Table 1. The effects of Optaflexx on steer performance and carcass characteristics

	Treatment	
Item	Control	Optaflexx
Total gain, lb[a]	570	601
Dry matter intake, lb/day	19.50	19.64
Daily gain, lb/day[a]	3.43	3.59
Feed:gain[a]	5.70	5.49
Dressing percentage	63.30	63.60
Hot carcass weight, lb[a]	816	834
% carcasses > 949 lb[a]	3.90	8.30
Marbling score[1]	492	496
Ribeye area, square inches[a]	14.05	14.32
USDA yield grade	2.8	2.8

[a]Optaflexx, $P \leq 0.05$.
[1]500 = small/choice.

Optaflexx did not significantly alter dressing percentage, but it increased hot carcass weight by 17 lb. There were also a greater number of heavy weight carcasses when Optaflexx was fed. Feeding Optaflexx increased ribeye area in cattle by 1.9%, but had no sig-

nificant impact on the USDA quality and yield grades of the carcasses.

As expected, greater time on feed increased hot carcass weight, dressing percentage, and the percentage of USDA Prime and Choice carcasses. The number of yield grade 4 and 5 carcasses also was increased as days on feed increased. In addition, cattle performance worsened as time on feed increased; there were decreases in average daily gain and overall feed intake, and an increase in feed:gain (Table 2). The inclusion of Optaflexx in the diet for 28 days before each of the harvest dates provided a positive performance response in each of the three groups (data not shown).

Table 2. The effects of days on feed on steer performance and carcass characteristics

	Days on Feed		
Item	150	171	192
Total gain, lb[a]	564	571	620
Dry matter intake, lb/day	19.7	19.7	19.3
Daily gain, lb/day[a]	3.8	3.4	3.3
Feed:gain[a]	5.18	5.79	5.83
Dressing percentage[a]	62.4	63.6	64.2
Hot carcass weight, lb[a]	790	823	862
% carcasses > 949 lb[a]	1.4	4.8	12.1
Marbling score[a,1]	477	493	511
Ribeye area, square inches[a]	13.88	14.06	14.62
USDA yield grade[a]	2.7	2.9	2.8

[a]Days on feed, $P \leq 0.05$.
[1]500 = small/choice.

Optaflexx had no effect on the abundance of β_1-AR mRNA or β_3-AR mRNA (data not shown), but there was an Optaflexx effect on the abundance of β_2-AR mRNA (Figure 1). Also, the abundance of β_1-AR mRNA and β_3-AR mRNA decreased as days on feed increased (Figures 2 and 4). Conversely, β_2-AR mRNA abundance increased as days on feed increased (Figure 3). The amount of β_2-AR mRNA was nearly 200 times greater than the amount of β_1-AR mRNA after 171 days on feed, and was approximately 160 times greater at 192 days on feed.

It is believed that ractopamine-HCl mediates its response through the β_1-AR. The data from this study show a decrease in β_1-AR mRNA as cattle are on feed for a longer period of time, but there was still a positive response to Optaflexx for all three harvest dates. In addition, there was an increase in the abundance of β_2-AR mRNA as days on feed increased, and feeding Optaflexx also increased the abundance of β_2-AR mRNA. The results from this study provide evidence that cattle preferentially express more β_2-adrenergic receptors with increasing days on feed. These changes could have dramatic effects on performance if a high-affinity, β_2 adrenergic agonist (not ractopamine-HCl) was fed during this period.

Our data showed that Optaflexx feeding numerically increased the expression of the β_2-adrenergic receptor and had no effect on the β_1-adrenergic receptor. Much *in vitro* research suggests that a specific ligand down regulates its own receptor over time. Our data does not support previous findings because the β_1-adrenergic receptor was not affected, and the β_2-adrenergic receptor abundance increased, due to Optaflexx feeding.

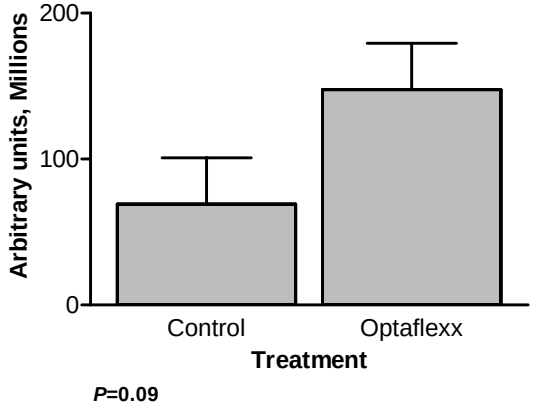

Figure 1. Main effects of Optaflexx on β_2-adrenergic receptor mRNA.

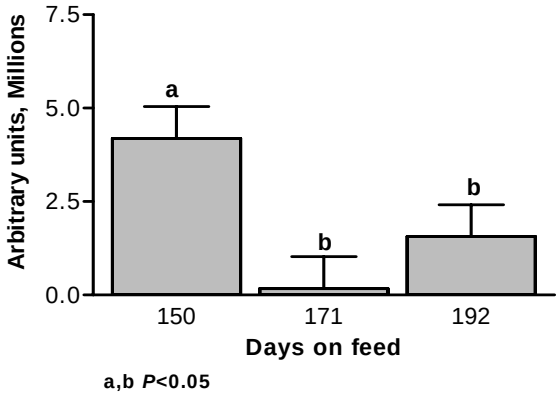

Figure 2. The abundance of β_1-adrenergic receptor mRNA at three different harvest dates.

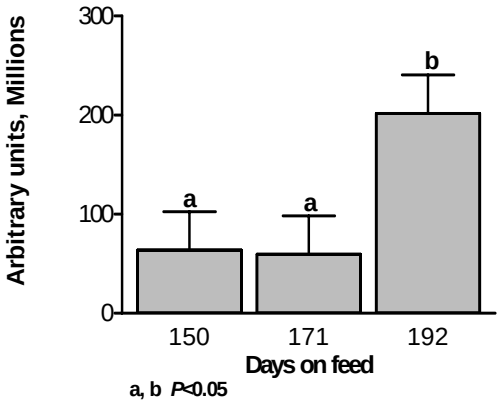

Figure 3. The abundance of β_2-adrenergic receptor mRNA at three different harvest dates.

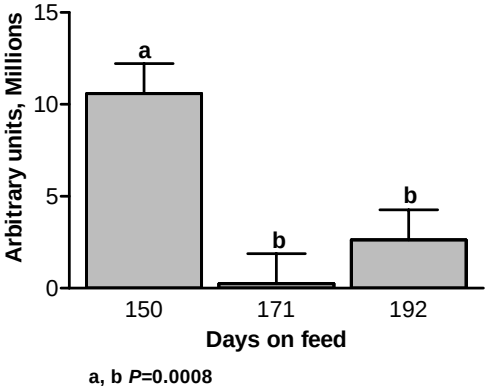

Figure 4. The abundance of β_3-adrenergic receptor mRNA at three different harvest dates.